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Original Research Article

Evolution of Traffic Noise Impacts in Amman, Jordan

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Abstract

Amman, the capital of Jordan has been subjected to persistent increase in road traffic due to overall increase in prosperity, fast development and expansion of economy, travel and tourism leading to the traffic noise being a growing environmental problem. This study investigates the changes over the years in the magnitude of the traffic noise pollution, the attitude of the residents towards the problem and estimates its economical impact.

Measurements were made at selected locations and compared with published figures at the same locations in order to identify the changes over time. The impact of the problem on the exposed residents was also evaluated through carrying out a social attitudinal survey and the results were compared with those of similar studies. An attempt is also made to value and put a monetary value for traffic noise.

The results confirm that traffic noise levels are growing over the years and their social and economic impacts are also both growing and becoming more significant

Keywords: Jordan, traffic noise, attitudinal survey, noise valuation.

1. Introduction

Traffic noise is one of the most immediate and identifiable environmental problem associated with rapid industrialization, urbanization and population growth. Rapid urbanization, industrialization, expansion of road network and infrastructure cause severe noise pollution problem [1]

Jordan with an area of 93000 sq. km. has a total population of about 6.53 million, 85% of which live in urban areas and over half live in the capital city, Amman which possesses about 85% of the total large industrial development and 71% of small ones. The population of Jordan increases at an annual growth rate of about 2.5%. [2] This coupled with the rapid industrialization created new conditions of living which

created noise to the already existing air, water and soil pollution. This new pollution has been noticed to increase at a rate which seems to be higher than that of the population with growing concern from the neighbouring residents.

This study aims to detect the variation of traffic noise problem regarding its magnitude represented by the noise levels, and the attitude of dwellers towards the epidemic through the years from 1997 to 2012, in order to provide a better understanding of the noise issue and its impact.

This study also attempts to evaluate the economic impact of road traffic noise in Jordan through supplying cost bands i.e maximum-minimum cost values.

2. Magnitude of Traffic Noise

The daily activities of urban communities have been invaded by noise from different sources with traffic noise being reported as

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the major source of the urban noise pollution [3]

The issue of traffic noise in Jordan has been drawing an increasing attention over the last few years, due to its increasing magnitude. In order to recognize the development of the problem, the magnitude of traffic noise levels was measured and compared through the years from 2005 to

2012 for 26 selected locations in Amman city. For the purpose of comparison, this study used the same method of noise measurements as that used in the earlier studies from which data were extracted. The noise levels were measured during the peak morning hours from 7:00 am till 8:00 am and during the evening hours 19:00-20:00 pm. The results are listed in table 1.

Table 1. Measured day-time and night-time noise level L10 (1 hr) in 2005, and 2012

| Location Number | Identification | Day | | Night | |
|-----------------|----------------------------|------------|------------|------------|------------|
| | | L10 (2005) | L10 (2012) | L10 (2005) | L10 (2012) |
| 1 | Interior circle | 67 | 71 | 65 | 73 |
| 2 | First circle | 66 | 64 | 61 | 56 |
| 3 | Second circle | 66 | 66 | 60 | 61 |
| 4 | Third circle | 68 | 67 | 65 | 64 |
| 5 | Fourth circle | 65 | 66 | 65 | 67 |
| 6 | Fifth circle | 66 | 70 | 61 | 68 |
| 7 | Sixth circle | 62 | 67 | 59 | 67 |
| 8 | Seventh circle | 65 | 68 | 58 | 65 |
| 9 | Eighth circle | 64 | 73 | 69 | 70 |
| 10 | Sport city circle | 70 | 78 | 67 | 68 |
| 11 | Abdoun circle | 53 | 66 | 60 | 66 |
| 12 | Swieleh circle | 78 | 71 | 66 | 70 |
| 13 | Gardens Street | 73 | 72 | 69 | 70 |
| 14 | Safeway-Gardens junction | 73 | 71 | 70 | 73 |
| 15 | Allstiqlal street | 78 | 79 | 70 | 73 |
| 16 | Airport Highway | 69 | 80 | 65 | 78 |
| 17 | Queen Rania st. | 76 | 72 | 62 | 72 |
| 18 | Al-Sinaa' street | 68 | 73 | 63 | 70 |
| 19 | Jordan street | 73 | 77 | 68 | 74 |
| 20 | Al-Mahatta street | 81 | 80 | 71 | 72 |
| 21 | King Hussien street | 77 | 76 | 64 | 74 |
| 22 | Cairo street | 46 | 70 | 58 | 70 |
| 23 | Khalid Bin Alwaleed street | 72 | 71 | 66 | 66 |
| 24 | Zahran street | 61 | 79 | 67 | 80 |
| 25 | South buses terminal | 70 | 71 | 68 | 71 |
| 26 | Raghdan buses terminal | 80 | 79 | 69 | 73 |

The results displayed in table (1) shows large variation in the magnitudes of noise levels between locations ranging from 46 to 81 dB during the day and between 53 and 80 dB during night. The levels during day and night showed increasing trends over the years reaching as high as 55 % between 2005 and 2012 at some locations such as Cairo street. This dramatic change is influenced by the affecting factors mainly traffic volume [4,5].

3. Attitudes towards Traffic Noise

Traffic noise is a rapid growing epidemic which does not only influence those who actually use the transportation system but

also affects the quality of life and activities of those who are exposed to such noise. Traffic noise is considered as one of the important sources of noise pollution that adversely affects human health through causing ear discomfort, decreasing work efficiency, making nervous system disorder, disturbing rest and sleep, causing harm for children and women physiological function and danger for heart diseases.

This study uses the results of a three social surveys carried out in 1994, 2005 and 2012 to declare the influence of traffic noise on the standard of living of residents exposed to excessive road traffic noise, and how this influence varies through the years. These

results are listed in table 2.

The noise level figures depicted in table 1 demonstrated that the city of Amman suffers an increase in noise levels during day and night times through the years 2005 to 2012. However people may had cope to noise as an average of 49% of respondent annoyed while reading, studying and doing their job in 1994, in comparison to 65% in 2005 and 34% in 2012. The decrease in percentage of people annoyed by traffic noise maybe due to that people are getting use to the noise.

It can be noticed that an increased number of resident considering changing their places of residence as a result of noise effects. This percentage increased from just over 50% in 1994 and 2005 to 65% in 2012.

Regarding public awareness of traffic noise, the study revealed increasing awareness with 80% of the respondents are aware of the negative impact of noise on health and on the environment in 2012 compared to only about 65% in the other two years. Furthermore, the 2012 study showed that more than 50% of the people are willing to contribute to be part of the change, as they are willing to contribute toward the cost of attenuation measure [4,5,6,8].

Table 2. Comparison between 2005 And 2012 Results

| | 1994 | 2005 | 2012 |
|-----------------------------------|------|------|------|
| Annoyed while studying | 40% | 56% | 51% |
| Annoyed while watching TV | 38% | 50% | 39% |
| Annoyed while speaking | 34% | 35% | 50% |
| Affect job accuracy | 24% | 53% | 47% |
| Lose concentration while studying | 40% | 74% | 74% |
| Annoyed while sleeping | 53% | 37% | 33% |
| Causes environmental pollution | 80% | 67% | 61% |
| Public health problem | 79% | 68% | 68% |
| Consider moving away | 65% | 51% | 54% |
| Close the window | 55% | 50% | 65% |

4. The Economical Effect of Noise Pollution

A number of estimations made in different countries conclude that the annual cost of urban road noise is surprisingly higher than it might seem. Such costs can represent unpredicted economic losses due to the fact that they are mostly external costs that do not seem very critical and are often

neglected, especially in developing countries. External costs are defined as costs that affect outside parties (non-users) of the transport system. They include, but are not limited to, traffic noise, air pollution, traffic congestion and traffic accidents.

A number of empirical studies conducted helped in the process of noise cost estimation. Some showed numerical relations between the intensity of noise and the value of property exposed, others directly linked the vehicle mileage with the noise cost. Setting certain assumptions and rounding up values to averages.

Different methods proposed to establish a set of cost estimations resulting from different methodologies/models. The different models will include exposure factors, total length of urban roads exposed, amount of surplus noise intensity (Generally anything Above 70dB) and possibly other factors to carry out an estimated total cost of noise. The different costs obtained by different models/methods can then be either combined into a single average value, or represented as a min-max band of total noise cost allowing for any possible uncertainties. The latter was adopted in this study

For consistency purposes, the following assumptions are used to estimate the noise cost under Jordanian conditions :

- An average noise level of 70 dB(A) is used.
- Noise depreciation index of 0.5% of property value per decibel increase.
- Only noise levels above 55dB are considered.
- An average of 60 properties per KM along urban arterials in Amman are exposed to more than 55dB level of noise.
- The average value of a single property in Amman is equal to JD75000 (\$ 112000)

Four different methods were considered in the estimation of noise cost, the Min and Max values obtained were then used to establish a min-max band. The methods are Hedonic Pricing Method

This method relates the cost of noise to the

number of dwellings affected, and represents depreciation in the value of those dwellings due to traffic noise.

Annual Noise Cost = (Exposure * Surpass Degree of Noise * Depression Index * Property Value)

Exposure = (Length of Exposed Roads * Average Number of dwellings per KM)

Surpass Degree of Noise = Actual Degree (dB) – Maximum Tolerable Degree (dB)

Depression Index = 0.5% (As assumed above)

Property Value = JD 75000 (As assumed above)

Annual Noise Cost = Length * (60) * (70-55) * 0.5% * 75000
= 337500 * Length

Assuming Total Length of the exposed major arterials in Jordan = 500KM

Annual Noise Cost = 170 Million JD / Year
Estimation using Accident Cost

The relationship between the cost of accidents and the noise cost are estimated as:

Noise Cost = 0.33 * Accident Cost

Accident Cost = 336 Million JD

Annual Noise Cost = 112 Million JD / Year
Estimation using Capita Income

Some studies estimated noise cost to be equal to 0.35% of Capita Income.

Noise Cost = 0.0035 * Capital Income * Population

Capital Income = 3710 JD, Population = 6.318 Million

Annual Noise Cost = 82 Million JD / Year
Estimation using GDP

Gross Domestic Product (GDP) can also represent a measure of the cost of Traffic Noise. Studies show that noise cost is equivalent to 0.4% of GDP.

Noise Cost = 0.004 * GDP

GDP = JD13440 Million

Annual Noise Cost = 54 Million JD / Year

Based on the results obtained by the different methods above, we can establish a noise cost min-max band of JD 54 – 170 million per year.

To put this in perspective, the annual

accident cost in Jordan was estimated to be JD 336 million per year. The max cost of noise is equivalent to almost 51% of accident costs, assuring its critical importance.

The prediction and treatment of the financial impact imposed by the traffic noise is of critical importance. Developing countries still lack this sort of studies, and that is heavily influencing the quality of life and greatly reducing the efficiency of transportation systems. It should also be mentioned that more effort should be placed in re-assessing the values of cost; more factors should be added to the models in order to add precision to such critical studies and render it useful for any future needs.[6]

5. Conclusions

This study investigates the changes over the years that have occurred in the levels of traffic noise along Amman urban road network, the attitude of the exposed residents towards this environmental pollution. The study also presents an attempt to valuate traffic noise.

The magnitude of problem was found to increase over the years during day and night and still exceed the maximum allowable limits. The results of the study reveal that all the locations where traffic noise levels were measured are environmentally polluted with noise levels reaching as high as 81 dB(A) in 2012. This doesn't compare favourably with the proposed maximum level of 60 dB (A) adopted by the authorities. The effect of these high levels on people was to the extent that 65% of the residents adjacent to these sites consider changing their place of residence. The results of the attitudinal survey show an increase in the awareness of residents about the problem where 80% of them realize that it is an environmental problem.

The various methods used to devise a monetary value to traffic noise in Jordan concluded a minimum-maximum band of JD 54 million- JD 170 million equivalent to

\$81million - \$255 million.

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